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THE RCS PROCEDURES TRAINER:  
SOMETHING OLD, SOMETHING NEW

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A new concept for a highly versatile, very low cost procedures trainer counters the trend toward devices that are unnecessarily elaborate, too expensive and time consuming for training development, and overly restrictive in options available to the author. The trainer provides a highly interactive, self-paced training environment that captures the essence of hands-on training for perceptual and other cognitive skills. It is well-suited for training control panel and keyboard procedures, navigation, tactics, strategy, equipment familiarization, problem solving, troubleshooting, and maintenance.

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## INTRODUCTION

The RCS-100 Procedures Trainer is a response to the need for a low cost trainer that can provide an effective training environment with minimal authoring resource requirements. The design goals included:

- 1) low acquisition cost per station
- 2) hands-on trainee interaction
- 3) transportable
- 4) computer-based
- 5) flexible author control over cueing and feedback
- 6) trainee controlled branching
- 7) effective instruction strategy and instructional features
- 8) two-and/or three-dimensional training media
- 9) no dependence on instructional features that are expensive to deploy and are of limited utility for this type of trainer (such as automatic branching, video disc, etc.)
- 10) flexible authoring options for evaluating trainee responses
- 11) no programming knowledge needed for the author or trainee
- 12) easy to change training modules
- 13) modular software for ease of expansion of features by the user
- 14) automatic scoring

These design goals are based on the assumptions that:

- 1) applications will not require real-time dynamics;
- 2) applications will not require veridical proprioceptive feedback;
- 3) there is no need for automatic generation of simulations or problems;
- 4) response sequences may have more than one correct or acceptable series of actions.



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The advent of low cost computers and the availability of a sonic digitizer has made it possible to develop an economical trainer which allows the trainee to use a touch "volume", as opposed to a touch screen or panel. The trainee views instructions and graphics on a video monitor and uses a stylus to touch critical points on two-dimensional graphics or three-dimensional objects placed in the volume.

The RCS-100 trainer is illustrated in Figure 1.

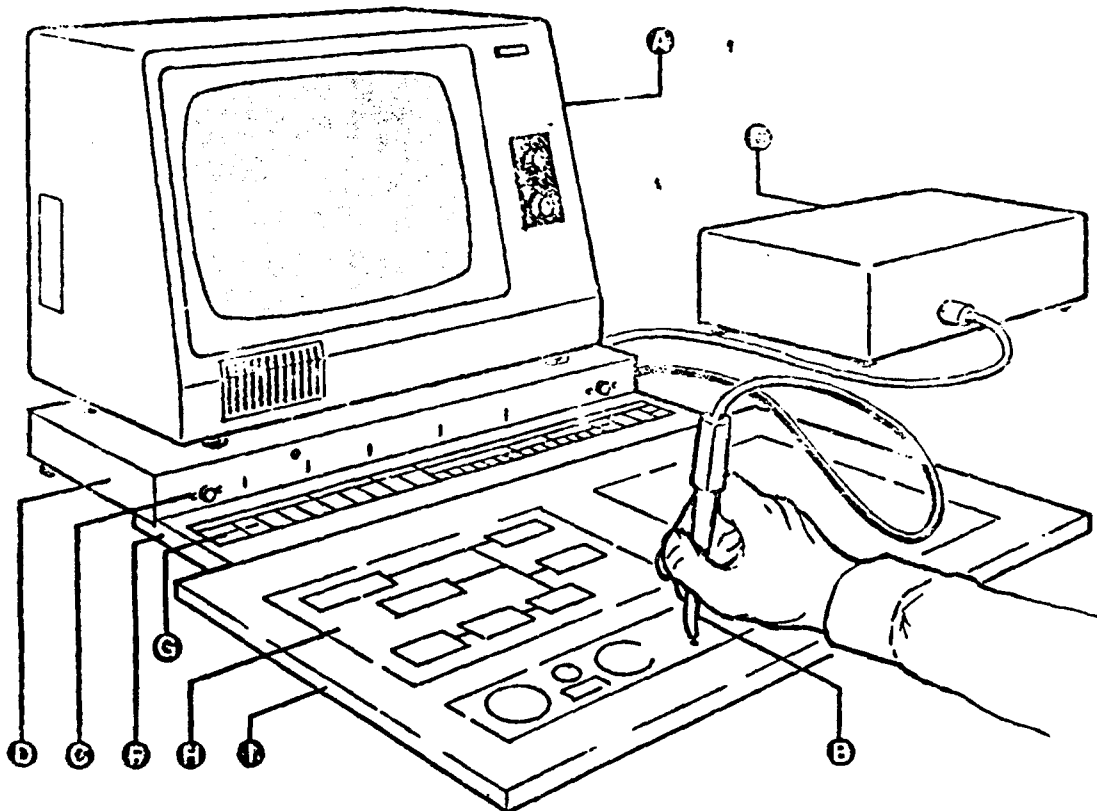


Figure 1. Components of the RCS-100 Procedures Trainer

It shows these components:

A - a video monitor on which is displayed the text of the lessons, prompts, and helps.

B - an electronic stylus which emits a click when touched to any surface or object within its working area

C - microphones that pick up the clicks from the stylus

D - a sonic digitizer that converts the clicks into a localization of the tip of the stylus so that the point being touched can be quantified

E - a micro computer and disk drive which provides the lessons to the screen, evaluates the correctness of the trainees sequence of touches, and provides computer managed instruction features

F - an assembly that keeps all of the trainee's work area perfectly registered with the digitizer

G - a Function Key Strip that provides computer-aided instruction features such as Helps, branching to out of sequence pages such as for remediation, start the page or lesson over, and many more features that are already included in a version of this trainer for non-handicapped individuals.

H - photographs, forms, checklists, diagrams, or any real or simulated three-dimensional objects that represent the learning environment with which the trainee must interact to learn the procedures or strategy of vocational tasks.

I - a work surface to which the items in H are affixed, measuring 22 inches wide by 18 inches deep

The touch volume is a section of a cylinder, 24 inches wide and a radius of approximately 20 inches, less a 2-inch inactive area next to the digitizer as shown in Figure 2. The section is dependent on the configuration, but is typically a quadrant with expansion possibilities to nearly a half of a cylinder.

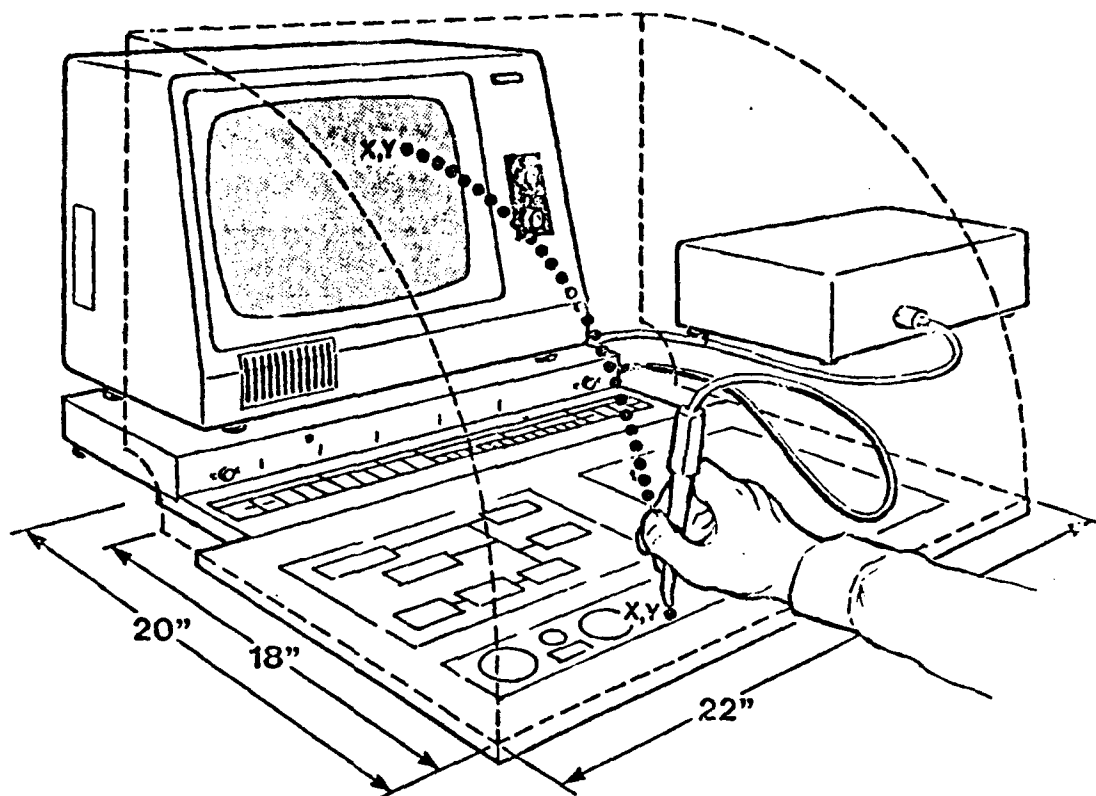


Figure 2. Working area of the RCS-100 Procedures Trainer.

The RCS-100 Procedures Trainer is an extraordinarily versatile device that is supported by an authoring system that is equally versatile and easy to use. Applications of the trainer are any procedural tasks that meet the assumptions listed above. These applications include:

- 1) familiarization with nomenclature and layout
- 2) set up and operation of control panels
- 3) procedures for solving navigation, tactical, or other spatially oriented problems
- 4) procedures for operating equipment (including keyboards)

- 5) problems that require the trainee to visualize relationships among a number of variables
- 6) troubleshooting procedures
- 7) maintenance procedures

Hardware has been selected that keeps the cost low, but without sacrificing features. The RCS-100 trainer is priced at \$4500 for complete student and authoring systems and hardware, but multiple purchases can drive the cost significantly under \$4000. The software, although copyrighted by RCS Company, is available for modifications by the owner/author. A central computer with multiple stations can be considered, but the economics depends on the configurations required.

## CONCEPT OF OPERATION

The digitizer is a means for quantifying the location of the stylus when the stylus is touched to a surface in the working area. When the tip of the stylus is depressed, a spark occurs near the tip. The digitizer has two microphones that pick up the sound of the spark and then translates the time of the sound's travel into the position coordinates of the stylus. If the stylus is in the next correct position, according to the lesson, then the computer will score the touch as correct. The stylus does not need to be in contact with any special surface. The trainee may be touching points on a picture of equipment or may be touching an actual piece of equipment.

Each page of a lesson consists of up to 23 lines of text plus a title and page number line at the top and a message line at the bottom. Associated with each page is a set of responses that are required of the trainee. The trainee responds by touching locations on the picture of the equipment, the object placed on the work area, or the Function Strip that is mounted at the top of the work area. The use of the Function Strip touch keys is explained in Table 1. These keys give the trainee access to all of the instructional features built into the RCS-100 trainer.

TABLE 1  
FUNCTION KEY and DESCRIPTION

LOAD DISK Use to change disks. Restarts RCS-100 program from the beginning. Resets all variables for the disk that is inserted.

END LESSON Shows scores. Resets time and errors.

TIME OUT Stops the clock. Locks out all responses except: Table of Contents, Helps, End Lesson, Reload Disk, and Time In.

TIME IN Cancels Time Out.

PART 1, PART 2, PART 3 Goes to the first page of the selected part of the current lesson.

START LESSON OVER Goes to Part 1, Page 1 of the current lesson.

BACK ONE PAGE Goes to previous page in lesson sequence.

START PAGE OVER Goes to first response of the current page.

CONTINUE Goes to next page in lesson sequence or helps.

RETURN Goes to current page of text from Table of Contents, Helps, Scores, or to the page from which you branched using the GO TO PAGE function.

SCORES Displays current scores and time. Use RETURN to proceed.

HELPS Goes to first page of module helps. Each touch goes to next page of module helps and then the successive pages of helps for the current lesson (repeats sequence upon further touches).



**TABLE OF CONTENTS** Goes to first page of TABLE OF CONTENTS. Each touch goes to next page of Table of Contents and then repeats from page one. Use RETURN or GO TO PAGE to proceed.

**GO TO PAGE** Follow by entry of page number (see ALPHANUMERICS, below). Branches to that page but remembers the page that you left.

**ALPHANUMERICS** Touch keys in sequence when asked to make an entry. Touch ENTER only after entire answer appears as you want it.

**ENTER** Use to confirm your answer or your selection of page number for branching.

**ERASE ENTRY** Lets you restart your answer, or cancels your selection of GO TO PAGE.

A disk may contain some or all of the lessons making up one instructional module. Each lesson may be made up of any combination of three Parts plus a set of Helps pages. Part 1 is typically used to present background information or general knowledge about the topic of the lesson. Part 2 is used to present the detail of a procedure and examples. Part 3 may be used to give the trainee practice problems to gain mastery of the procedures, however unlike Parts 1 and 2, prompts may be given to the trainee if three errors in a row are made. The prompt might be the correct answer, a reminder about a common error, or instructions to branch to another page (or lesson) for remediation. Helps pages, selected by touching the HELPS function key, may be included in the lesson to give general information, remedial information, discussions of common errors, and so forth.

## RESPONSE BLOCKS

One of the major features of the RCS-100 is the flexibility given to the author for specifying the sequence of responses for any page. When the author wants the trainee to respond to some point in the work area, an acceptance area is defined which is a rectangle of any size or shape (but whose sides are parallel or perpendicular to the digitizer). The rectangle is specified by the upper left and the lower right corners selected by the author. The simplest response block is just a single acceptance area. When it is selected, the trainee must touch the stylus within that area in order to be scored correct and allowed to go on.

Procedures are not always a simple sequence of responses that must be made in only one order. Sometimes there are equally correct alternative sequences that the author may wish to allow. For example, a procedure may call for three independent actions that may be done in any order, such as the trainee indicating that three indicator lamps turn on. In this case, the author selects the response block in which three acceptance areas are designated and the computer looks for one response in each area to score the trainee as correct.

A list of responses for a page of text is a sequence of Response Blocks. Each block may be made up of from one to four acceptance areas, indicated as areas A, B, C, or D, as follows:

- (1) A (a simple, single response)
- (2) A and B (in any order)
- (3) A and B and C (in any order)
- (4) A or B (but not both)
- (5) A or B or C (but only one of them)
- (6) A or B-followed-by-C
- (7) A-followed-by-B or C-followed-by-D

In the sixth case, one may define area C to be the same as area A. In that event the author has defined an optional response, B -- one that may be made by the trainee, but is not really necessary and should not be scored as incorrect if not made. Other interesting combinations may be generated using the seventh block in the list.

There are three other Response Blocks possible:

(8) straight line (no specific end points). The author specifies a straight line to be selected or drawn by the trainee. The author defines the line by indicating any two points on it (from which its orientation, or slope, is calculated), a region through which it must pass (to make sure it is not displaced too far to one side or the other), and the leeway allowed in the orientation (plus or minus some number of degrees).

(9) response key sequence. The response portion of the Function Key strip contains the digits 0 through 9, the letters A through E, the words YES and NO, and some punctuation marks. If the author wants the trainee to answer an objective type question (multiple choice, true-false) or to indicate an answer for a calculation or a value that would appear in a display, the author would select this response block and specify the exact response to be made.

(10) function key. Every page must have at least one response associated with it. Typically, the last response for a page (or the only response if no logical interaction is possible as may often occur in Part 1 of a lesson) is to touch the CONTINUE function key to "turn" the page. If this response block is not specified at the end of the response block sequence for a page, the next page will automatically appear after the last correct response.

## AUTHORING SYSTEM

The RCS-100 Authoring System is designed to allow training developers who are not programmers to author lessons which use the full capability of the built-in instructional features. Only non-standard applications which require special graphics or audio/speech programming would require a specialist's services.

As a general rule, all authoring is done first as a paper simulation. Each page is formatted on an authoring coding form. On the same form, the author details the series of acceptable responses and enters any special "bookkeeping" information required by the software to allocate the correct amount of space for the data. This technique, unlike working from a software driven menu, allows an author the freedom to work remotely from the hardware and to circulate the lesson for review before it is entered.

The authoring forms are designed to be job performance aids. The author checks off the appropriate options and enters the bookkeeping data. The form's format corresponds to the sequence that is used to enter the lesson into the computer. To enter the data, the author loads the authoring program and enters the data and text via the computer keyboard and the acceptable responses via the stylus and keyboard.

The author has complete freedom to incorporate any type of visual material into the lesson as long as it can fit into a 16 x 24 inch area (the depth of the area is reduced to 16 inches to accommodate the function key strip). One may use line drawings, photographs, diagrams, maps, forms, charts, and so forth, as well as additional representations such as printed versions of messages that a trainee could select to show communications he would make over a voice link. Any representation of an environment or a potential response is allowable, as are

appropriate three-dimensional objects placed within the "touch volume".

The author may use more than one picture or object in a lesson. The instruction to change from one to another is easily incorporated into the page of the lesson when the change should take place.

## APPLICATIONS

A recently completed program for the Naval Training Equipment Center, Orlando, FL, demonstrated the trainer's application to two widely varying tasks. One was a basic course in the use of the Maneuvering Board navigation plotting sheets. Trainees worked directly on the sheets with pencils, using the stylus to indicate the points that they plotted, lines that they drew, and values of ranges and bearings that they calculated. The second task was to learn the alternative set-ups for an IFF control panel. Using a much earlier prototype of the trainer, a sample lesson was developed to teach one of the procedures for transmitting a message on the B-52 Air Force Satellite Communication System.

An Air Force Office of Scientific Research program, using a non-computerized version of this technique, indicated that trainees may be expected to have enhanced retention of newly acquired or periodically refreshed skills than with conventional techniques. Certain identifiable individuals may even be expected to benefit more from learning via photographs than with actual equipment.